MICRO AND NANO MANUFACTURING

CourseCode	20ME6603	Year	III	Semester	II
Course Category	HONORS	Branch	ME	Course Type	Theory
Credits	4	L – T – P	3 – 1– 0	Pre requisites	MSM,MP
Continuous Internal Evaluation	30	Semester End Evaluation	70	Total Marks	100

Course Outcomes: Upon successful completion of the course, the student will be able to

	Statement	Skill	BTL	Units
CO1	Understand manufacturing considerations at the micro and nano scale.	Understand Communication	L2	1,2,3,4,5
CO2	Create and characterize nanostructures for a particular industrial application	Apply, Communication	L3	2
CO3	Select appropriate manufacturing methods to create micro sized components	Apply, Communication	L3	3,4
CO4	Design and select industrially-viable processes, equipment and manufacturing tools for specific industrial products.	Apply, Communication	L3	5

Contribution of Course Outcomes towards achievement of Program Outcomes & Strength of correlations (3:High, 2: Medium, 1:Low)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	3	2	2	3				2				2	2
CO2	2	2	2	3	2				2				2	2
CO3	3	2	2	2	3				2				2	3
CO4	3	3	3	2	3				2				2	3

Syllabus

UNIT	Contents	Mapped COs
I	Introduction: Importance of Nano-technology, Emergence of Nanotechnology, Bottom-up and Top-down approaches, challenges in Nanotechnology. Nano materials Synthesis and Processing: Methods for creating Nanostructures; **Processes for producing ultra-fine powders**: - Mechanical grinding; Wet Chemical Synthesis of nanomaterials - sol-gel process, Liquid solid reactions; Gas Phase synthesis of nanomaterials- Furnace, Flame assisted ultrasonic spray pyrolysis; Gas Condensation Processing (GPC), Chemical Vapour Condensation (CVC)- Cold Plasma Methods, Laser ablation, Vapour - liquid -solid growth, particle precipitation aided CVD, a summary of Gas Condensation Processing (GPC).	**CO1**
II	Structural Characterization: X-ray diffraction, Small-angle X-ray Scattering, Optical microscopes and their description, Scanning Electron	

	Microscopy (SEM), Scanning Probe Microscopy (SPM), TEM and EDAX analysis, Scanning Tunneling Microscopy (STM), Atomic force microscopy (AFM).	**CO1, CO2**
III	Microfabrication Techniques: Lithography, Thin Film Deposition and Doping, Etching and Substrate Removal, Substrate Bonding. MEMS Fabrication Techniques, Bulk Micromachining: Processes used for shaping and sizing of micro products and macro products and Nano finishing techniques, Surface Micromachining, High- Aspect-Ratio Micromachining.	**CO1, CO3**
IV	Nanofabrication Techniques: E-Beam and Nano-Imprint Fabrication, Epitaxy and Strain Engineering, Scanned Probe Techniques, Self-Assembly, and Template Manufacturing. MEMS devices and applications: Pressure sensor, an inertial sensor, Optical MEMS and RFMEMS, Micro-actuators for dual-stage servo systems.	**CO1, CO3**
V	Applications of Nano and Micromachining in Industry, **Typical machining methods:** Micro-turning, Micro-drilling and Micro-milling, Product quality in micromachining Micro-grinding and **Ultra-precision Processes**: Introduction, Micro and Nano grinding, Nano grinding tools Applications in optical manufacturing, Semiconductor and electronics related applications.	**CO1, CO4**

Learning Resources
Text books
1.Tai-Ran Hsu, "MEMS and Microsystems: Design and Manufacture," McGraw- Hill, 2008. 2.V. K. Jain, "Introduction to Micromachining", 2nd Edition, Alpha Science, 2014. 3.Mark James Jackson, "Microfabrication and Nanomanufacturing", CRC Press, 2005.
Reference books
1. J. A. Collins, Failure of Materials in Mechanical Design: Analysis, Prediction, Prevention, 2/3, John Wiley & Sons, 1993
E- Resources & other digital material
1.https://nptel.ac.in/courses/102108078